Novel Construction Fall Plenary Session 2016

“New Field-Applied Anti-Corrosion System for Pipelines with Moist Surfaces”

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1. History of DENSO

Rising in the midst of collapse

14/11/1922: The company is founded in Berlin under the name “Chemieprodukte GmbH”. Against the backdrop of a post-war 1920s Germany that is suffering famine, hyperinflation and unemployment, the company lays the foundations for its future "Made in Germany" story of success.

Redefining corrosion prevention

14/07/1927: The “DENSO-Tape” (Petrolatum-Tape) is patented and goes down in history as the fledgling company's first invention. The DENSO-Tape is the world's first passive corrosion prevention solution for pipes and pipelines. The name "DENSO" comes from the Latin word "densus", which means "to seal".

From the Spree to the Rhine

After the destruction of the company's original premises (in Berlin) during the Second World War, the company reforms in Leverkusen.

The proximity of the new site to BAYER AG and the Rhine river provides the inspiration for new inventions – and an efficient transport route.
1. History of DENSO

DENSOLEN®: Preserving value with 3-ply tape
1973: DENSO Group Germany invents the world's first co-extruded three-ply PE/Butyl-tape for welding connections on pipes and pipelines.

TOK®-Band: Taking quality to the roads
1977: The world's first bitumen joint tape for joints and seams in asphalt road construction is invented. The TOK®-Band name quickly becomes a synonym for all bitumen joint tapes.

TOK®-Sil Resist: A new product for new partners
2014: The world's first joint sealant for biogas plants and liquid manure, slurry and silage effluent plants provides an effective, permanent seal at the critical point – the intersection between horizontal and vertical joints.
1. Fields of Activities

DENSO – Advanced in sealing – with innovative products for...

- corrosion prevention of pipes and pipelines,
- sealing of joints and seams in asphalt and concrete surfaces,
- noise reduction and vibration damping of rails and tracks,
- sealing of concrete protective walls,
- environmental protection against aggressive fluids,
- protection of jetty piles in piers and harbours,
- protection of sewerage systems,
- isolation of air condition and ventilation plants...
- etc.
2. Requirements for Passive Corrosion Prevention

- UV resistance
- Temperature resistance
- Indentation resistance
- Impact resistance
- Electrical Isolation
- Impermeable for oxygen and electrolytes
- Scratch resistance
- Microorganism resistance
- Long term expectancy
- Chemical resistance
- Bending strain resistance
- Lap shear resistance and adhesion strength

Moist Surfaces
3. Condensate on Pipeline Surfaces

Reasons for condensate on pipeline surfaces:

- Pipelines are under stress and in operation.
- High temperature differences between pipeline medium and ambient temperature.
- High humidity.

Conventional Corrosion Prevention Coatings cannot be applied onto pipelines with moist surfaces.
3. Effects of condensate on pipelines

- Dramatically pressure reduction needed, due to not dryable surfaces.
- Processing of the coating work is delayed.
- In worst case scenarios the pipeline must be shut down for a longer period.

Consequences: high losses in income for operators caused by reduced transport or delayed work.
3. Current proceedings with moist surfaces

- If there is condensate on a pipeline, and the pipeline is still in operation:
  
  Installing air driers in a tent

  Consequences: time-consuming, complex and expensive.

- Even with Epoxy Coatings (designed for use on moist surfaces), the general surface preparation standard SA 2½ is mandatory!

  Very often blasting on pipelines which are in operation very time-consuming and expensive.
3. Target: to find a perfect system

Requirements

1. Ease of application.
2. No flame needed (for pipelines in operation/pre-heating).
3. No sand-blasting (for pipelines in operation).
5. Excellent long-term corrosion prevention.
6. Excellent mechanical protection.
7. Economical advantage.

What technology has proven to be the best, for nearly a century?
4. Petrolatum Tapes: History

Since 1927 the use of Petrolatum Tape is a continuous success story!
4. Petrolatum Tapes: Properties

Advantages & Properties:

- No contamination as no abrasive blasting is used.
- Environmentally friendly as they do not contain Volatile Organic Compounds (VOC) or odour.
- Best suited for irregularly shaped geometries, such as flanges, valves and T-pieces.
- Excellent corrosion prevention.
- Not be affected by water, acids, salt and soil organic elements.
- Fast and easy application.
- Moisture displacing properties.
5. PE/Butyl Tapes: History (1/2)

- **1958:** The worldwide first butyl rubber sealing tape (DENSIT®) was introduced to the market. This tape had no carrier foil.

- **1960ies:** 2-ply PE/Butyl-Tapes entered the market.
  - PE/PVC carrier foil with an (usually) butyl rubber adhesive.
  - When used as 2-Tape system:
    - Inner wrap (tape 1): designed for corrosion prevention
    - Outer wrap (tape 2): mechanical protection.

When using a 2-ply PE/Butyl-Tape as corrosion prevention tape (inner wrap), spiral corrosion will most likely occur – since there is no self-amalgamation of the individual layers...

Consequences: Bad experiences with “PE/Butyl-Tapes”...
5. PE/Butyl Tapes: History (2/2)

- **1973:** The 3-ply PE/Butyl-Tapes (DENSOLEN®) were invented and introduced to the markets:
  - Co-extruded 3-ply self-amalgamating tape.
  - PE carrier foil with butyl rubber on both sides.
  - The fused layers (outer layer and inner layer) form a water and oxygen-tight protective hose (when wrapped around the pipe).
  - Used as single-tape or two-tape/multi-tape systems.
  - **No more spiral corrosion!**
5. PE/Butyl Tapes: Properties

**Advantages & Properties:**

- Excellent corrosion prevention (3-ply Tapes).
- Excellent mechanical protection (Stress class “C” acc. EN 12068).
- For high temperatures.
- Very easy to apply: no flame, continuous application, simple, repairable, fast - also with automatic wrapping devices.
- No problems with air enclosures.
- No poor adhesion due to insufficient pre-heating.
- No problems due to insufficient mixing of two-components systems.
- But difficult to apply on wet surfaces.
6. The Challenge

- How to protect a pipeline with moist surfaces against corrosion and mechanical impact, while
  - Not shutting down the pipeline,
  - Not using a flame,
  - No sand blasting,
  - Not using extra equipment (heaters, tents, etc.)
  - Fast and ease of application, avoiding mistakes,
  - Easy to repair/adjust
  - ...

Heat Shrinkable Sleeves, Epoxy Coatings, Polyurethane Coatings, PVC-Tapes, Bitumen-Tapes, standard PE/Butyl-Tapes and standard Petrolatum-Tapes are not applicable as a single solution...
6. The Challenge

- The best solution would be a combination of Petrolatum (moisture displacing properties) and 3-ply PE/Butyl-Tape (hose-like coating and high mechanical resistance)

- With the currently available solutions on the market:
  - PE/Butyl-Tapes are not compatible to Petrolatum-(Tapes).
  - PE/Butyl-Tapes have no/poor adhesion on Petrolatum-(Tapes).

Solution: The worldwide first combination of Petrolatum and PE/Butyl-Tape: VivaxCoat®-System
VivaxCoat® is a new coating system for a permanent corrosion protection of steel pipelines and components up to 60°C (+140°F) operating temperature and mechanical resistance up to stress class C acc. to EN 12068.

The system consists of:
- Corrosion Prevention Primer: DENSO®-AQ Primer
- Corrosion Prevention Tape: DENSO®-MT Tape
- Mechanical Protection Tape DENSOLEN®-AS50
7. VivaxCoat®-System: Components

1. DENSO®-AQ Primer:
   - No grit blasting mandatory.
   - Easy application.
   - No special application tools.
   - Application directly onto moist or wet surfaces!
   - Moisture and condensate displacing properties.

DENSO®-AQ primer
7. VivaxCoat®-System: Components

2. DENSO®-MT Tape:

- Innovative modified Petrolatum-Tape in accordance with EN 12068.
- Consists of a robust polypropylene non-woven and a corrosion prevention mastic based on petrolatum.
- High dripping point and good adhesive resistances at high temperatures.
- Only one layer application with 50% overlap.
7. **VivaxCoat®-System: Components**

### 3. DENSOLEN®-AS50

- Self-amalgamating 3-ply PE/Butyl-Tape.
- Superior mechanical protection.
- The self amalgamating butyl layers create a hose-like coating.
- Second barrier of corrosion prevention!
- No oxygen or vapour are getting into the system.

**DENSOLEN®-AS50** and **DENSO®-MT Tape**

will provide a self-amalgamating connection!

Thus one will achieve a cohesive break during a peeling test!
8. Fields of Application

Pipelines installed in the soil, armatures and flanges.

Suitable as well for:
- Air-to-ground-transitions
- Stoppes
- T-pieces
8. Fields of Application

VivaxCoat®-System fulfills class HR and THR of GRTgaz (France) for permanent operating temperatures up to + 60°C. (+140°F).
8. Field Cases: ONTRAS Gastransport/Germany

Gas-Pipeline (DN 900) as a rehabilitation system for damaged sections here, initially coated with glass fibre reinforced system.
8. **Assessment made by ONTRAS/Germany**

**Evaluation results by ONTRAS:**
- Minimizing danger of application faults.
- Excellent application of all system components.
- Only little surface preparation necessary.
- Ambient conditions are not relevant to the quality of the coating.

**Application fields at ONTRAS:**
- Armatures in different dimensions.
- Air-to-ground-zones.
- In special construction plants or difficult located areas.
- In areas of changing temperatures.

**ONTRAS was very satisfied with the overall technical performance of the VivaxCoat®-System!**
8. Field Cases: “Inselspital”
(hospital in Bern/Switzerland)

Due to condensation of humidity on the cold pipe surface, corrosion was detected on the pipes. After the application of the VivaxCoat®-System, a thermal isolation was applied above the coating to minimize energetic losses.

Corrosion on the surface

DENSO®-AQ Primer and DENSO®-MT Tape
8. Field Case: STORENGY Cerville/France

Gas blowdown line

- Pipe diameter: DN 200
- VivaxCoat® -System used as rehabilitation system
- Replacing damaged glass fibre reinforced system.
8. Field Cases: GRTgaz Oost Cappel/France

Main line
Pipe diameter DN 900
9. **Summary and Outlook**

- Only little surface preparation is required.
- Coating of pipes under load is possible.
- Very good resistance against salt containing atmospheres and soils.
- Excellent bond between PE/Butyl-Tape and modified Petrolatum-Tape.

- Versatile application fields including flanges, armatures and T-pieces.
- Onshore and offshore usage.
- Meets the requirements for indentation and impact resistance according **class C EN12068**.
- System for operating temperatures up to **+110°C** (+230°F) in preparation.
Thank you !!
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